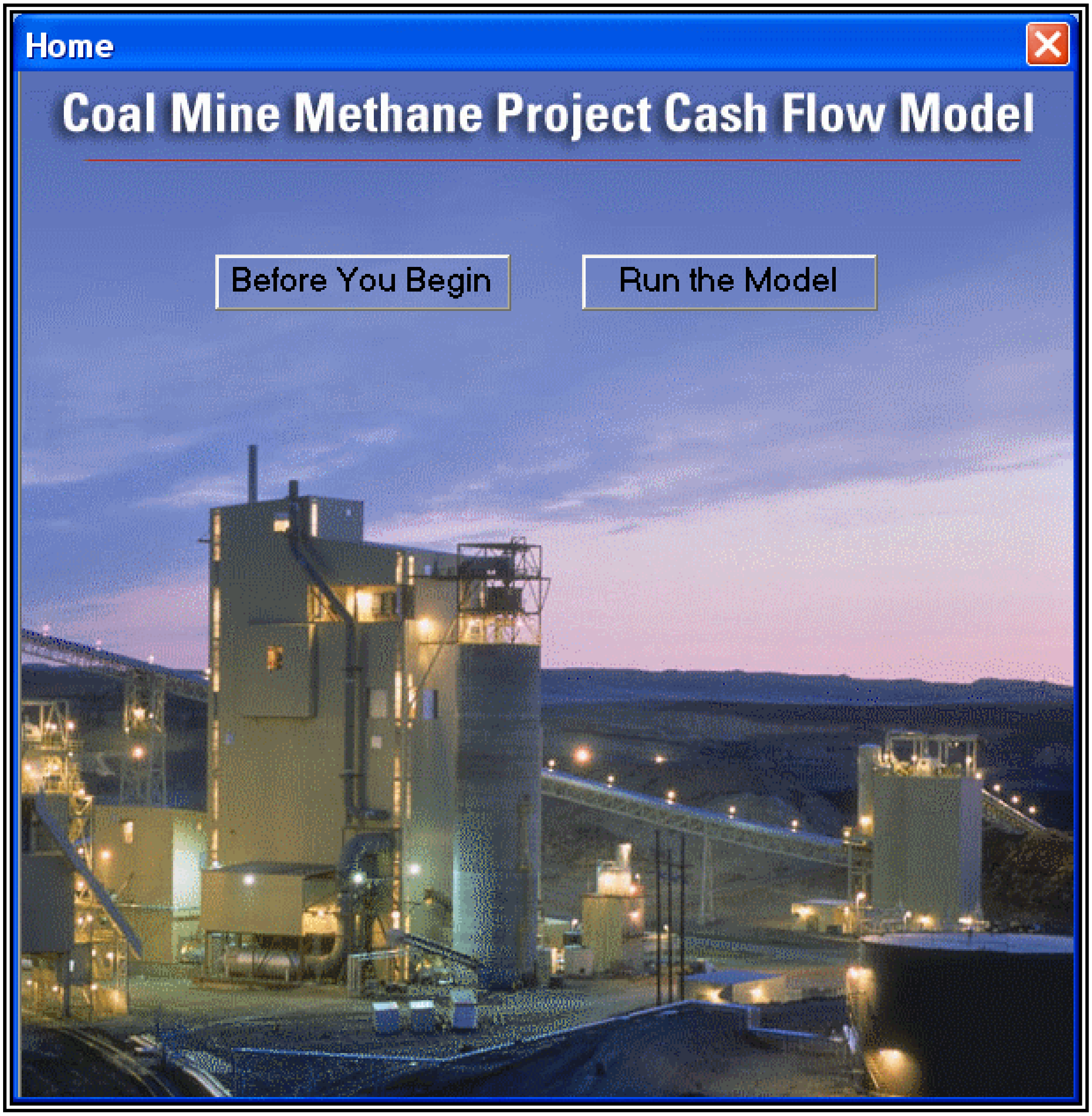
User's Manual for the CMOP Cost-Benefit Analysis Model

U.S. EPA
Coalbed Methane
OUTREACH PROGRAM



September 2008

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1.0 Introduction

Welcome to the Coal Mine Methane Project Cash Flow Model. The U.S. Environmental Protection Agency's Coalbed Methane Outreach Program (CMOP) designed the model to help you—a coal mine owner/operator, project developer, or other interested party—evaluate the potential economic viability of recovering and beneficially using coal mine methane in one of six different ways.

The model was NOT DESIGNED for conducting a detailed economic analysis or for designing a coalbed methane project. A detailed feasibility assessment should be conducted by qualified professionals experienced in coalbed methane recovery and use, prior to preparing a system design, initiating construction, purchasing materials, or entering into agreements to provide or purchase energy from a coal mine methane project. To start your search for a project developer or for a service or equipment provider in the CMM industry, visit the CMOP Network Contacts list (www.epa.gov/cmop/networkcontacts.html).

CMOP is a voluntary outreach program with a mission to promote the profitable recovery and use of coal mine methane (CMM), a greenhouse gas more than 20 times as potent as carbon dioxide. By working cooperatively with coal companies and related industries, CMOP helps to address barriers to using CMM instead of emitting it to the atmosphere. In turn, these actions mitigate climate change, improve mine safety and productivity, and generate revenues and cost savings.

Input and Output

The model was designed for users who have readily accessible data specific to a coal mine, but who do not necessarily have the data, experience, or knowledge to evaluate a coal mine methane project.

The user will be required to enter data specific to a coal mine and coal mine methane (CMM) project needs. For data related to the CMM project technology, EPA has provided an extensive set of default values that eliminate the need to be familiar with CMM technologies. You can override defaults if you have more specific data.

Using the combination of user-provided and default parameters, the model calculates the discounted cash flow, discounted Net Present Value, and the Internal Rate of Return for the project.

The model's output includes the following:

- Capital cost
- Operating cost
- Size of the project
- Sellable renewable energy credits
- Economic value
    - Internal Rate of Return (IRR)
    - Net Present Value (NPV)
    - Cash flow

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2.0 Getting Started

This User's Manual is organized to follow the model input screens. Follow the instructions below to open and use the model. Once you have the model up and running, the User's Manual leads you through the data input screens and model output screens. You will learn how to print or save results. Finally, you can check Section 4 to learn more about the model's assumptions for each project type.

Open the Model

Use a PC running a recent Microsoft Windows Operating System and Excel. For example, use Microsoft Windows XP and Vista Operating Systems and Excel 2003 or Excel 2007. Do not use a non-Microsoft Windows Operating System.

Save the model to your local drive. Do not open the model until you have changed the attributes and Security Settings as described below.

<u>Attributes</u>. Before opening the model, right click on the file name. Select **Properties**. On the **General** tab, check **Read-only** under Attributes. This prevents you from accidentally corrupting the file.

<u>Security</u>. Before opening the model, open Excel and set the Security Level.

- In Excel 2003, go to the **Tools** menu and select **Options**. On the **Options** window select the **Security** tab, then click on the **Macro Security…** button. Select either the **Medium** or **Low** options. Click **OK** to save your changes.

- In Excel 2007, click on the **Office Button**. Select **Excel Options…** at the bottom right. Select **Trust Center** from the left-hand menu, then select **Trust Center Settings**. Select **Macro Settings** from the left-hand menu. Select the button **Disable all macros with notification**. Select **OK** to save your changes.

> **Note About Macros in Excel 2007:**
>
> If you select **Disable all macros without notification**, the Print function is disabled and you cannot Print and Save results. However, if you select **Enable all macros (not recommended; potentially dangerous code can be run)**, then the Print function is enabled and you can Print and Save results as described at the end of Section 3.
>
> If you select **Enable all macros**, then you should return your Security Settings to disable macros after you have finished running the desired scenarios using the model. This will protect your computer when using other Excel files.

Open the model the same as you would open any Excel spreadsheet.

- In Excel 2003, select **Enable Macros** if prompted by the Security Warning Window. The Macros do not contain viruses. If you choose **Disable Macros**, then you will not be able to run the model.

- In Excel 2007, a Security Warning appears in the opened spreadsheet file. Next to the Security Warning, click on **Options…** Select the button **Enable this content**. Click on **OK** to save your changes.

<u>Screen Resolution</u>: If you cannot view the entire data entry screen, then you must change the screen resolution on your computer monitor:

- In Windows 2000, right click on the Desktop and select **Properties**. Select the **Settings** tab. Set the Screen resolution to no less than 1024 x 768.

- In Windows XP, right click on the Desktop and select **Properties**. Select the **Settings** tab. Set the Screen resolution to no less than 1024 x 768.

- In Windows Vista, right click on the Desktop and select **Personalize**. Select **Display Settings**. Set the Screen resolution to no less than 1024 x 768.

Use the Model

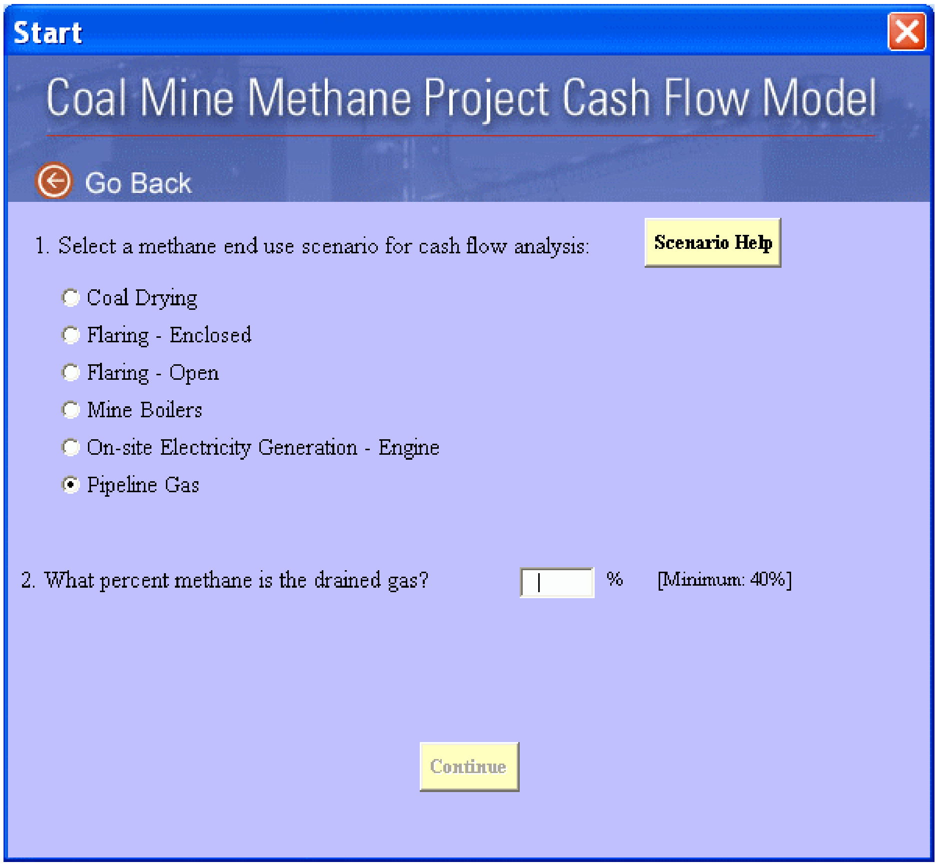
Although the model is constructed as an Excel spreadsheet, you will operate the model from Visual Basic screens. For all input screens, data must be entered in all fields to continue to the next screen. This can be either user-provided or default data.

When entering data, complete each field on all four tabs. You may use the **<<Back** and **Next>>** buttons to return to previous tabs to edit your data. Once you have completed all fields, the **Calculate** button becomes available. Select **Calculate** and the model generates a **Preliminary Report**.

Select **Units Help** at any time for definitions of units in the model.

3.0 Quick-Start Example Calculation

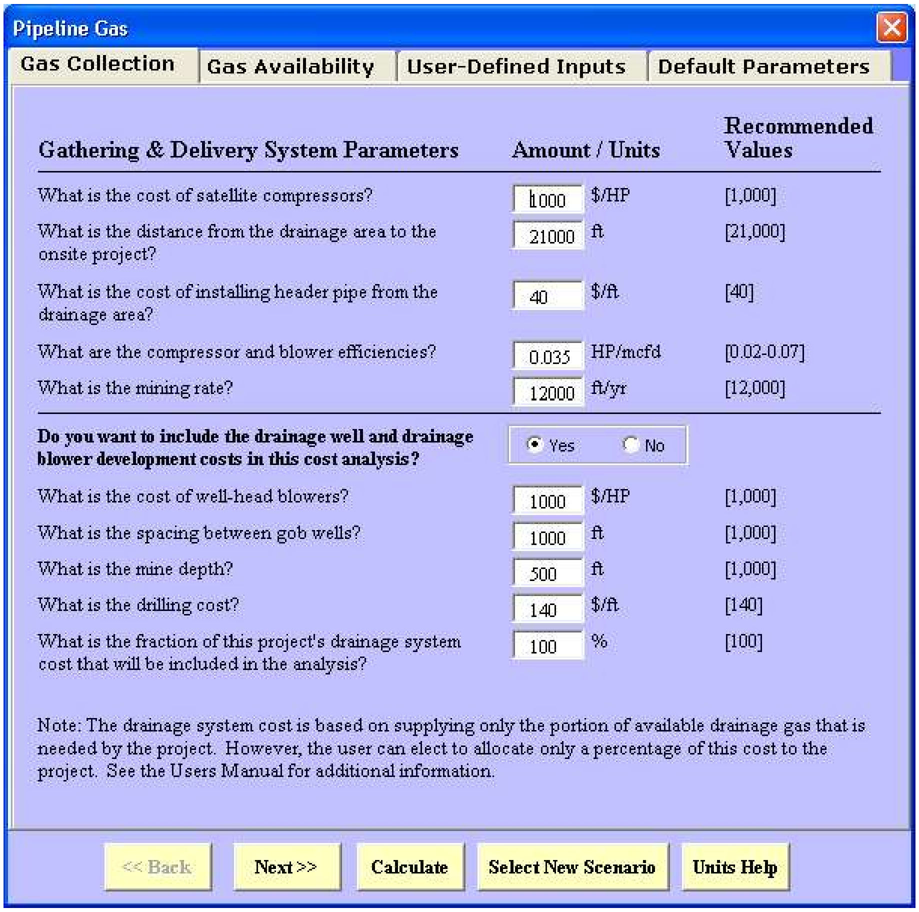
This section leads you through a quick-start example calculation to evaluate the feasibility of a coal mine methane project. The screen captures represent data that have been entered for a coal mine that is exploring a pipeline gas project. This quick-start example leads you to the report that appears at the end of this section.



Start

Start by selecting one of the six project types. Click on the **Scenario Help** button to learn more about each scenario. (See further details about each scenario in Section 4.)

Regardless of which scenario you select, enter the methane concentration of the drained gas. Each scenario has a minimum methane concentration, below which it will not perform correctly. If the methane concentration is below the minimum for the scenario you have selected, you will be instructed to select another scenario. Once you enter a methane concentration that is acceptable for the chosen end use scenario, select **Continue** to advance to the next input screens.



Gas Collection

The model uses the input from the **Gas Collection** tab to estimate the cost of the system that gathers and delivers the coal mine methane to the project.

Gathering and Delivery System Parameters

The first five questions address the system used to gather and convey the coal mine methane to the project. The costs for this portion of the system are included in the project cost and feasibility analysis. Collection piping and a compressor station are the primary components of this system.

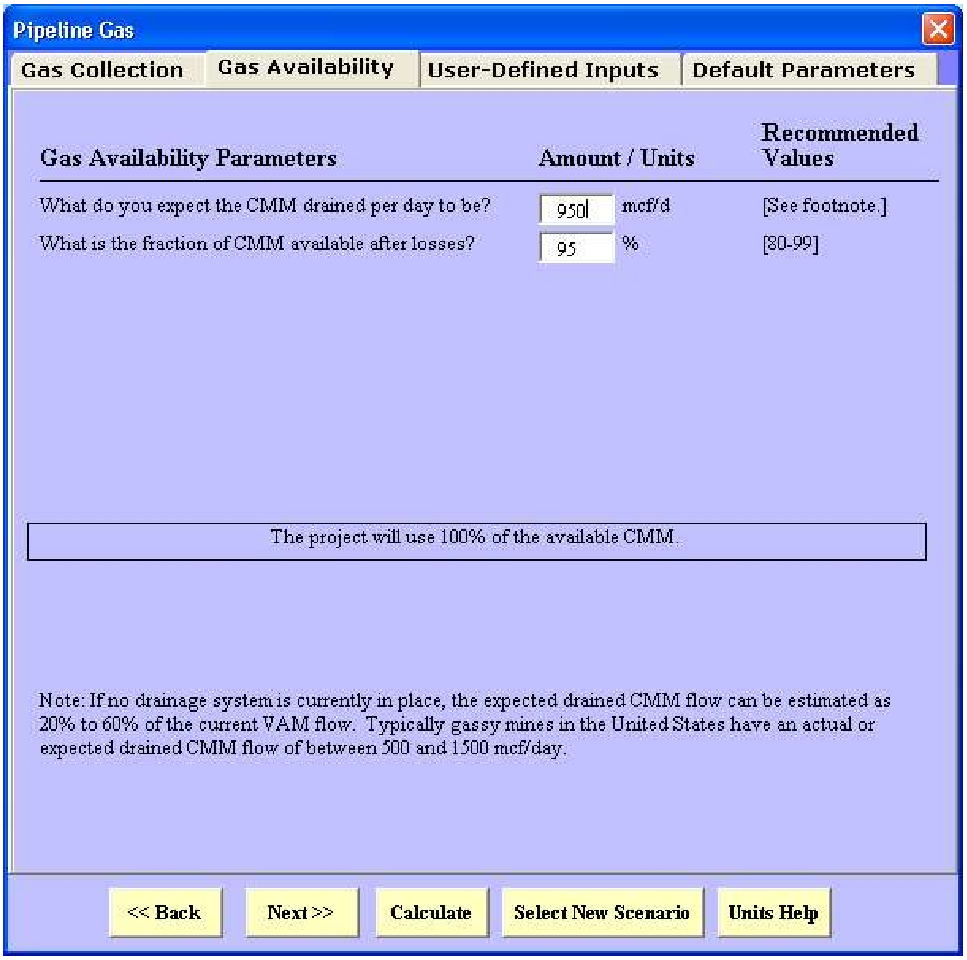
Drainage System Parameters

You can choose to include (**Yes** button) or exclude (**No** button) the drainage well and drainage blower development costs in the project cost analysis.

For example, if your coal mine does not have a drainage system in place, you will likely want to include these costs to give a better overall picture of the project. However, if the mine already has a drainage system in place for reasons such as safety, then you could exclude these costs and focus the analysis on the additional costs of just the energy recovery project.

When you select **Yes**, the model uses your drainage system inputs to cost the appropriate drainage system for draining the gas from the mine. If you select **No**, these data entry fields are inactivated.

When data entry is complete, select **Next >>** to go to the next tab.



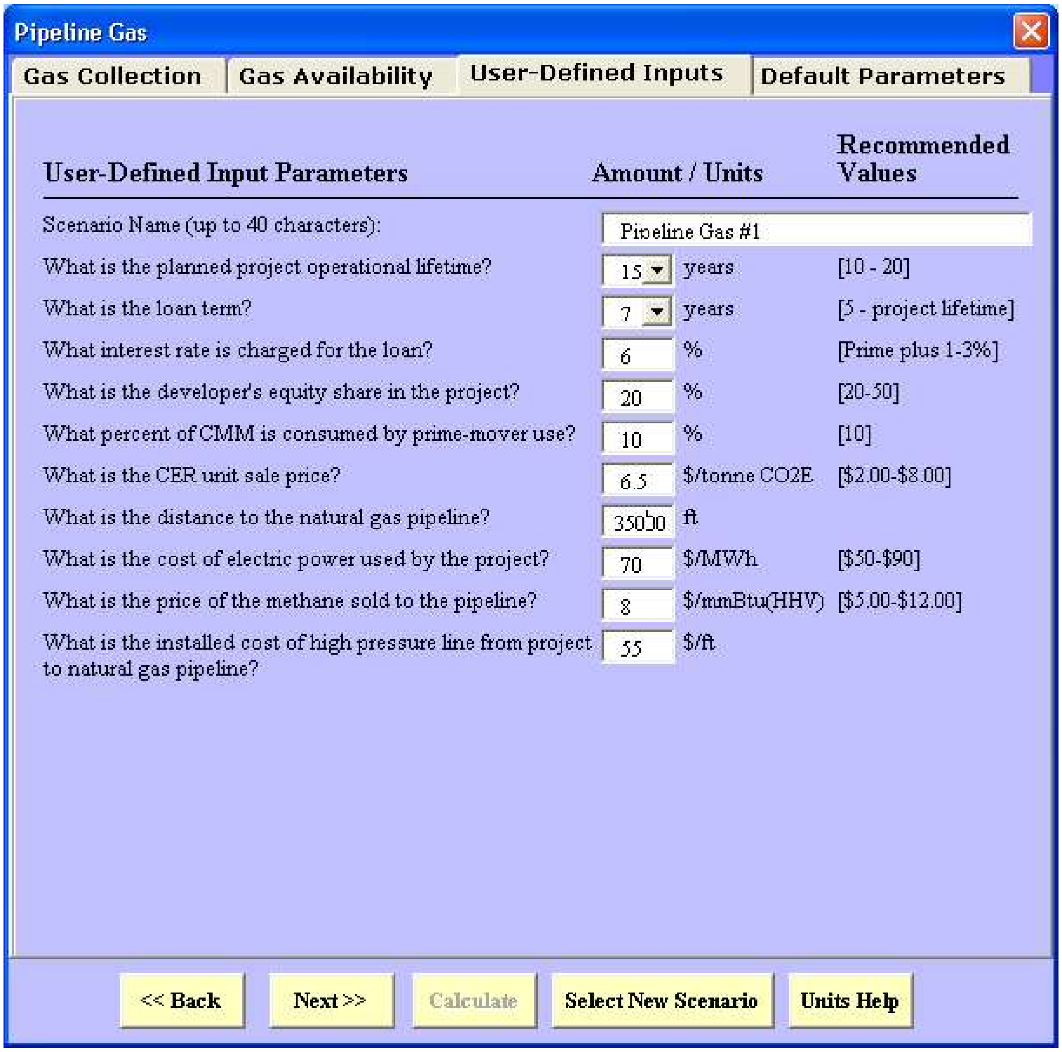
Gas Availability

The model uses the input from the **Gas Availability** tab to determine if enough gas is available for the project or if the project will have excess gas. The required data input for this tab varies with each scenario.

When you enter data, the model automatically calculates and presents the gas availability in the box located in the middle of the screen. For example, see "The project will use 100% of the available CMM" in the above screen capture.

For mines that do not supply 100% of the project fuel requirements, additional fuel would have to come from other sources such as coal. In other cases, the available gas may exceed the project's gas requirements. This excess gas is available for other projects and could be entered into other model runs to determine if an additional project was feasible.

When data entry is complete, select **Next >>** to go to the next tab.



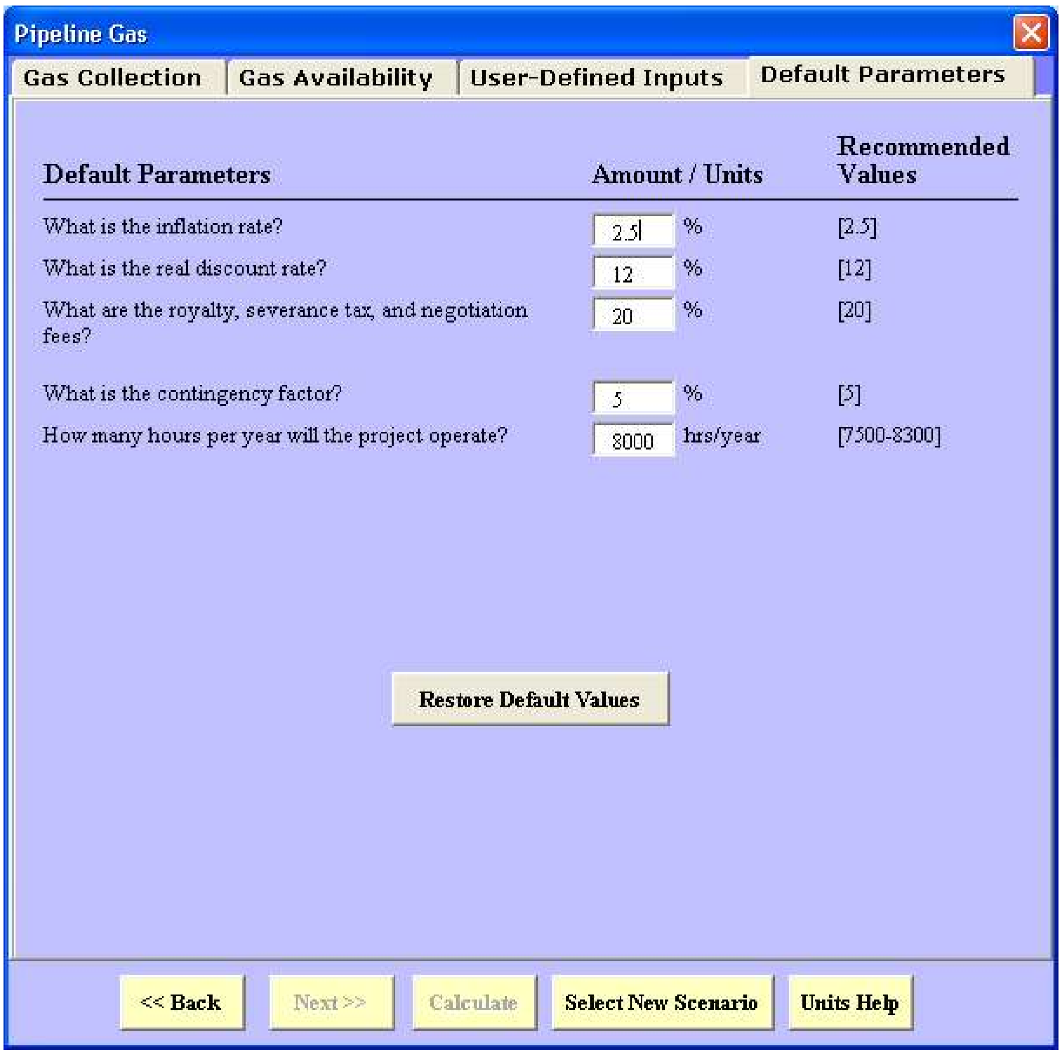
User-Defined Inputs

The **User-Defined Inputs** screen collects the key user inputs required by the model to conduct the economic analysis.

Name your scenario using up to 40 characters. When you Print or Save your scenario, the **Scenario Name** will appear at the top of the report. Note that the name of the end-use under analysis will not appear in the output report automatically and you will not be able to identify the end-use type unless it is specified in the Scenario Name.

Input for the **User-Defined Inputs** tab will vary greatly from user to user and project to project. Thus, EPA has generally provided a range of values rather than specific default values. You will receive a warning if you enter a value outside of the recommended range, but the model will use your value if you choose not to change it.

When data entry is complete, you have enough data to calculate the economic viability of your project. If you select **Calculate** from the User-Defined input tab, the model automatically uses the default data from the **Default Parameters** tab for calculations. However, you should review the default parameters to determine if any are inappropriate for your specific project. If you do want to edit the **Default Parameters**, then select from the **Default Parameters** tab and edit the data.



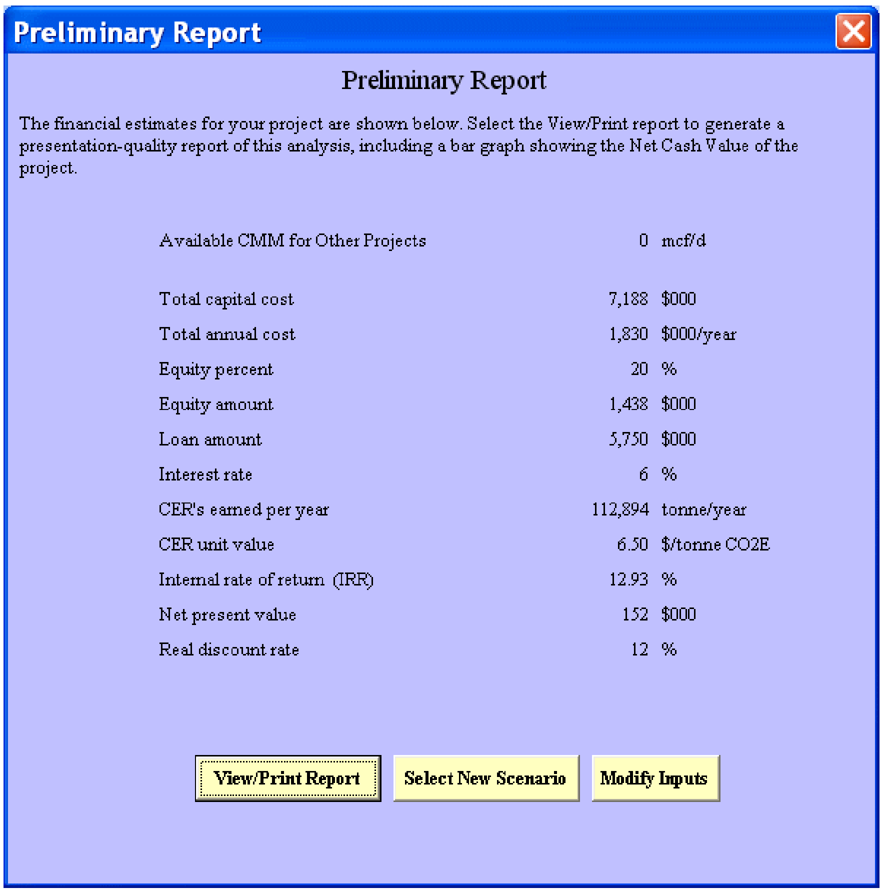
Default Parameters

The **Default Parameters** tab generally contains economic parameters that are typically independent of the project or mine.

Since many of these parameters may not be familiar to users, EPA has provided a full set of default parameters. However, users can override the default parameters. Selecting **Restore Default Values** restores the EPA-provided values.

From the **Default Parameters** input screen, you can select **<<Back** to review or edit your data in other tabs. You can also **Select New Scenario** to restart the model for a new scenario. However, all data entered for the current scenario will be lost.

When data entry is complete, select **Calculate** and the model generates a **Preliminary Report**.



Preliminary Report

The **Preliminary Report** presents the financial estimates for your project.

The **Available CMM for Other Projects** represents the volume of gas remaining, if any, that is available after meeting the project's gas needs. Data for the excess gas could be entered into a new scenario to determine if an additional project is feasible.

The **Total Capital Cost** is the sum of the initial, one-time cost outlay to install the methane **recovery** system and the initial, one-time cost outlay to set up the methane **utilization** system. This includes the cost of the satellite compressor station, the pipeline that connects the compressor to the gas project, and the cost of end-use equipment at the gas project. This may also include the cost of the blower system if the user chooses to include drainage system parameters in this analysis.

The **Total Annual Cost** is the sum of the annual costs to operate and maintain the methane **recovery** system and the annual costs to operate and maintain the **utilization** system. This includes the cost of piping and associated valves and meters necessary to get the gas from the wellhead to the compressor, and the cost of operating and maintaining the end-use equipment. This may also include the cost of drilling new gob wells if the user chooses to include drainage system parameters in this analysis.

Select **View/Print Report** for a two-page report that shows your project's financial results including a cash flow analysis, as well as your input. The hard copy of the report represents your record of this scenario run. Print this report for your files using the print menu. Following is an example of the report for the example case study presented above.

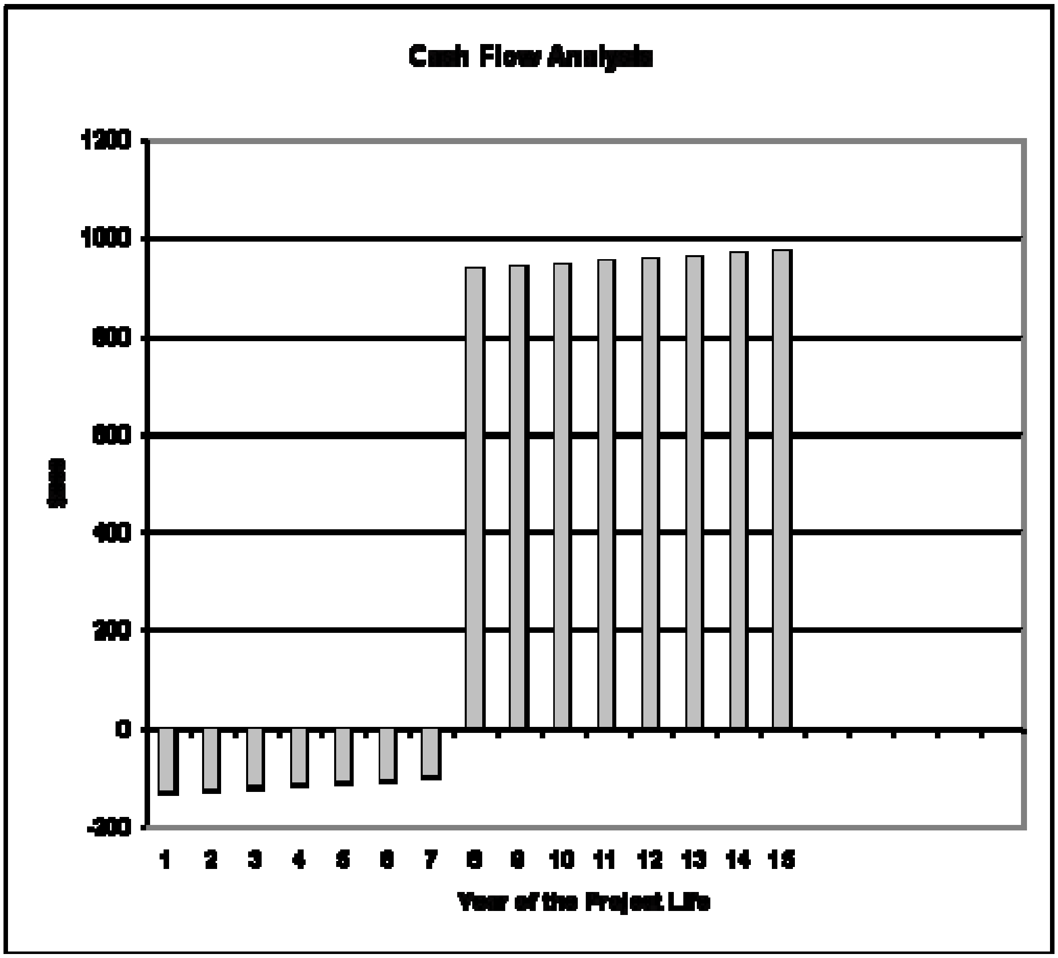
Coalbed Methane Scenario: Pipeline Gas #1

Scenario Inputs		
What percent methane is the drained gas?	85	%
Gathering & Delivery System		
What is the cost of satellite compressors?	1,000	$/HP
What is the distance from the drainage area to the onsite project?	21,000	ft
What is the cost of installing header pipe from the drainage area?	40	$/ft
What are the compressor and blower efficiencies?	0.035	HP/mcfd
What is the mining rate?	12,000	ft/yr
Drainage Well & Blower Development Costs		
What is the cost of well-head blowers?	1,000	$/HP
What is the spacing between gob wells?	1,000	ft
What is the mine depth?	500	ft
What is the drilling cost?	140	$/ft
What is the fraction of this project's drainage system cost that will be included in the analysis?	100	%
Gas Availability		
What do you expect the CMM drained per day to be?	950	mcf/d
What is the fraction of CMM available after losses?	95	%
User-Defined Inputs		
What is the planned project operational lifetime?	15	years
What is the loan term?	7	years
What interest rate is charged for the loan?	6	%
What is the developer's equity share in the project?	20	%
What is fraction of CMM consumed by prime-mover use?	10	%
What is the CER unit sale price?	6.5	$/tonne CO2E
What is the distance to the natural gas pipeline?	35000	ft
What is the cost of electric power used by the project?	70	$/MWh
What is the price of the methane sold to the pipeline?	8	$/mmBtu(HHV)
What is the installed cost of high pressure line from project to natural gas pipeline?	55	$/ft
Default Parameters:		
What is the inflation rate?	2.5	%
What is the real discount rate?	12	%
What are the royalty, severance tax, and negotiation fees?	20	%
What is the contingency factor?	5	%
How many hours per year will the project operate?	8,000	hrs/year

Coalbed Methane Scenario: Pipeline Gas #1

Estimated Outputs:

Available CMM for Other Projects	0	mcf/d
Total capital cost	7,188	$000
Total annual cost	1,830	$000/year
Equity amount	1,438	$000
Loan amount	5,750	$000
CER's earned per year	112,894	tonne/year
Internal rate of return (IRR)	12.93	%
Net present value	152	$000



Saving Your Results

The only way to save an electronic copy of your results is to use print software that generates and saves a pdf image of the report. If your computer has this software it can be accessed by opening the "**file**" menu and selecting the "**print**" option. This opens a print window that contains a list of printers available to your computer. The software that generates the pdf image will appear in this list with a name such as Adobe PDF, PDF 995, or PDF Factory. Select this pdf software and click on the "**OK**" button at the bottom of the print window. A new window will open and you will be asked to select the folder where the pdf file will be stored. Once you have selected the file for storing the report, click the "**save**" button at the bottom of the window. You have now saved an electronic image of your results.

Once you have printed or saved the scenario, you can **Modify Inputs** on the current scenario, or you can **Select New Scenario**. If you did not save or print results, you will lose results of the current scenario when you select a new scenario.

4.0 Technical Basis of the Model

Coal Mine Methane Drainage, Gathering, and Delivery System

The system for collecting drainage gas as defined in the model consists of two components: the CMM drainage system and the CMM gathering and delivery system:

1. The CMM drainage system includes the gob wells and the associated blowers that draw the gas from the gob wells. New gob wells are drilled every year as the mining progresses. Therefore, these costs are treated as annual operating costs. However, the wellhead blowers will be purchased at the start of the project and moved from well to well through time. The blower costs will be handled as an initial project capital costs.

2. The CMM gathering and delivery system consists of the piping and associated valves and meters necessary to get the gas from the well head blowers to the satellite compressor station and the pipeline that connects the compressors to the gas project or use. The piping and associated valves and meters necessary to get the gas from the well head blowers to the satellite compressor station must be installed annually as the mining progresses. Therefore, these costs are treated as annual operating costs. The satellite compressor station and the pipeline that connects the compressors to the gas project are one-time purchases and will be handled as an initial project capital cost.

The model always includes the cost of the CMM gathering and delivery system in the overall project cost, but allows the user to opt out of including the CMM drainage system cost in the overall project cost. In addition, the user can elect to include only a portion of the drainage system cost in the overall project cost. This option is used to simulate a case where the drainage system is already in place or is owned by an entity other than the developer of the project. This can also simulate a situation where the cost of the drainage system will be borne partially by the CMM project bottom line and partially be the coal sales bottom line, since the installation of a drainage system can increase mine productivity and decrease down time.

Recovery Annual Costs

Annual operating cost of recovering methane is composed of two elements:

1. Annual cost to install gob wells in the drainage system (W)
2. Annual cost to install gathering system piping (G) that connects the wells to the satellite compressors.

It is assumed that CMM is used for powering the blowers and compressors in the gathering and delivery system. This gas use is deducted from the gas delivered to the end use. However this gas must be included in the CER calculations since it is combusted and eligible for credits.

The annual cost becomes:

Annual cost = G + (W * F)
F = the fraction of the drainage system cost that is included in the project cost.

Gob well (W) cost inputs:
- Well spacing, ft/well (1,000 ft/well default)
- Mining rate, ft/yr (12,000 ft/yr default)
- Mine depth, ft (1,000 ft default)
- Unit drilling cost, $/ft (140 $/ft default)

Example gob well cost calculation using default values:

$$W = \frac{12{,}000\, ft/yr}{1000\, ft/well} \times 1{,}000\, ft \times 140\$/ft = 1{,}680{,}000\,\$/yr$$

Selecting the default mining rate of 12,000 ft/yr and the default well spacing of 1000 ft/well results in a model-assumed well instillation rate of 12 wells per year.

Annual gathering system (G) cost inputs:
- Mining rate, ft/yr (as above) (12,000 ft/yr default)
- Unit cost of pipeline installed (40 $/ft default)

Example gathering system cost calculation using default values:

$$G = 12{,}000\, ft \times 40\$/ft = 480{,}000\,\$/yr$$

Recovery Capital Costs

The capital cost of recovering methane is composed of three elements:

1. Blower (suction pump) cost (B)
2. Satellite compressor cost (C), and
3. Pipeline cost (P)

The capital cost equation becomes:

Capital cost = C + P + (B * F)

F = the fraction of the drainage system cost that is included in the project cost.

Blower (B) cost inputs:
- Blower cost, $/hp ($1000/hp default)
- Blower efficiency, hp/mcfd (0.035 hp/mcfd default)
- Gas flow rate, mcfd (no default)

B = ($1000/hp) * (0.035 hp/mcfd) * (*x* mcfd)

Compressor (C) cost inputs:
- Compressor cost, $/hp ($1000/hp default)
- Compressor efficiency, hp/mcfd (0.035 hp/mcfd default)

- Gas flow rate, mcfd (no default)

C = ($1000/hp) * (0.035 hp/mcfd) * (*x* mcfd)

Pipeline (P) cost inputs:

- Pipe cost, $/ft ($40/ft default)
- Pipeline length, ft (21,000 ft default)

P = ($40/ft) * (21,000 ft) = $840,000

Coal Drying

This scenario assumes that the mine will retrofit an existing coal dryer at an on-site coal preparation plant to burn methane drained from the mine instead of, or in addition to, burning coal. The scenario assumes that drained gas quality is adequate for the intended end use without requiring any processing (upgrading). Revenues in the form of savings accrue to the mine as a result of offsetting the cost of coal (including its transport cost) that otherwise would have been burned as fuel. Revenues also may result from the sale of carbon emission reductions.

Scenario Assumptions:

- The minimum methane concentration for proper firing is 40%.
- The dryers were originally coal fired (no natural gas option) and will continue using coal for the balance of the heat load not supplied by CMM.
- The theoretical heat required to dry a ton of coal is assumed to range from 0.15 to 0.4 MMBtu/ton, based on coal moisture and pore structure. The default is assumed to be 0.3 MMBtu/ton.
- The thermal efficiency of the dryer is assumed to range from 40% to 65% with a default of 50%.
- The recommended cost of the replaced coal is assumed to range from $25 to $50 per ton.
- The recommended avoided handling cost of the replaced coal is assumed to range from $0.5 to $1 per ton, with a default of $0.75 per ton.
- The recommended heating value of coal is assumed to range from 23 MMBtu/ton to 26 MMBtu/ton with a default of 24 MMBtu/ton.
- Utilization capital cost is for conversion of an existing dryer to co-fire CMM with coal, and ranges from $5,000/(MMBtu/hr) to $13,000/(MMBtu/hr) with a default of $7,000/(MMBtu/hr).
- The utilization annual cost of operating the new burner is assumed to be negligible as compared to the cost to maintain the coal feeder that was replaced.
- The hours/yr of operation are standardized with the other scenarios at a range of 7500-8300 hours and a default of 8000 hours. The dryer is expected to have a very high reliability, or availability, but is dependent on the availability of the CMM gathering system, which is continuously being moved and replaced as the mining advances along the coal seam.

Flaring – Open and Enclosed

The mine can flare the drained methane as long as it contains greater than 30% methane. These scenarios assume that the mine will install one or more open or enclosed flares. The cost of the flare includes monitoring and metering equipment in order to prove methane destruction because the only revenue source will be associated with the sale of certified carbon emission reductions.

Scenario Assumptions:

- The minimum methane concentration for safe flaring is 30%.
- The utilization capital cost for an installed flare is a function of the inlet gas rate. The default cost of an enclosed flare is $280/Mcfpd and ranges from $115 to $450/Mcfpd. The default cost for an open flare is $80/Mcfpd and ranges from $30/Mcfpd to $125/Mcfpd.
- The utilization annual cost of the enclosed flare is assumed to range from $10,000 to $20,000 per year with a default value of $15,000 per year. The utilization annual cost of the open flare is assumed to range from $5,000 to $15,000 per year with a default value of $10,000 per year.
- The hours/yr of operation are standardized with the other scenarios at a range of 7,500-8,300 hours and a default of 8,000 hours. The flare is expected to have a very high reliability, or availability, but is dependent on the availability of the CMM gathering system, which is continuously being moved and replaced as the mining advances along the coal seam.

Mine Boilers

The mine can use drained methane as a fuel for on-site boilers that provide space and/or water heating for mine facilities (e.g., washrooms, offices). This scenario assumes that the mine will retrofit an existing on-site boiler to burn methane drained from the mine instead of, or in addition to burning coal. The scenario assumes that drained gas quality is adequate for the intended end use without requiring any processing (upgrading). Revenues in the form of savings accrue to the mine as a result of offsetting the cost of coal (including its transport cost) that otherwise would have been burned as fuel. Revenues also may result from the sale of carbon emission reductions.

Scenario Assumptions:

- The minimum methane concentration for proper firing is 40%.
- Assume the boilers were originally coal fired (no natural gas option) and will continue using coal for the balance of the heat load not supplied by CMM.
- The recommended cost of the replaced coal is assumed to range from $25 to $50 per ton.
- The recommended avoided handling cost of the replaced coal is assumed to range from $0.5 to $1 per ton, with a default of $0.75 per ton.
- The recommended heating value of coal is assumed to range from 23 MMBtu/ton to 26 MMBtu/ton with a default of 24 MMBtu/ton.

- The utilization capital cost is for conversion of a boiler to co-fire with CMM and coal ranges from $5,625/(MMBtu/hr) to $12,500/(MMBtu/hr) with a default of $7,500/(MMBtu/hr).
- The utilization annual cost of operating the new burner is assumed to be negligible as compared to the cost to maintain the coal feeder that was replaced.
- The hours/yr of operation are standardized with the other scenarios at a range of 7,500-8,300 hours and a default of 8,000 hours. The boiler is expected to have a very high reliability, or availability, but is dependent on the availability of the CMM gathering system, which is continuously being moved and replaced as the mining advances along the coal seam.

On-site Electricity Generation – Engine

Drained methane can be used to fire internal combustion (IC) engines that drive generators to make electricity for sale to the local power grid. Even a mine that generates power to cover its own power needs only must usually connect to the power grid for the purposes of supply reliability. In this scenario the feasibility test involves considering the drained methane concentration. Some readily available IC engines are able to run on fuel that is as low as 25 percent methane if the fuel's oxygen level is high and its carbon dioxide content is low. For most situations a 25 or 35 percent cut off is reasonable. The scenario includes costs for gas processing to remove solids and water as well as the cost of equipment for connecting to the power grid. Revenues in the form of power sales accrue to the project as well as revenues that may also result from the sale of carbon emission reductions.

Scenario Assumptions:

- The minimum methane concentration of this scenario is 25%.
- The recommended electrical power efficiency is between 30% and 44% with a default value of 35%.
- The utilization capital cost for gas pretreatment, power generation and electrical interconnection equipment ranges from $1,100/kW to $1,500/kW with a default of $1,300/kW.
- The utilization annual cost is recommended to range between $0.015/kW-hr and $0.03/kW-hr with a default of $0.02/kW-hr.
- The price for selling the electricity from the project ranges from 0.04-0.1 $/kWh with a default value of 0.07 $/kWh.
- The hours/yr of operation are standardized with the other scenarios at a range of 7,500-8,300 hours and a default of 8,000 hours. The engines are expected to have a very high reliability, or availability, but are dependent on the availability of the CMM gathering system, which is continuously being moved and replaced as the mining advances along the coal seam.

Pipeline Gas

This scenario assumes the installation of a pressure swing adsorption type system to remove nitrogen and carbon dioxide down to a 4% inert level. The utilization cost is a function of both the inlet gas flow rate and methane concentration, and includes the cost of dehydration and compression necessary to process the gas and then to boost the sales gas to 900 psig (**Figure 1**). The project also assumes the installation of a catalytic oxygen removal system and a pipeline from the project to the natural gas transmission system. Revenues in the form of gas sales to a common carrier pipeline accrue to the project. Figure 2 illustrates the expected methane recovery as a function of inlet methane concentration. Revenues also may result from the sale of carbon emission reductions**.**

Scenario Assumptions:

- The contaminated tail gas is not utilized.
- The minimum methane concentration for the project type is assumed to be 40%.
- The pipeline cost is assumed to be $55/ft.
- The capital cost of the catalytic oxidation system is assumed to be $1.25 million.
- The utilization annual cost includes a fixed O&M of $300,000/yr and a variable O&M of $0.75/mcf.
- The hours/yr of operation are standardized with the other scenarios at a range of 7,500-8,300 hours and a default of 8,000 hours. The plant is expected to have a very high reliability, or availability, but is dependent on the availability of the CMM gathering system, which is continuously being moved and replaced as the mining advances along the coal seam.

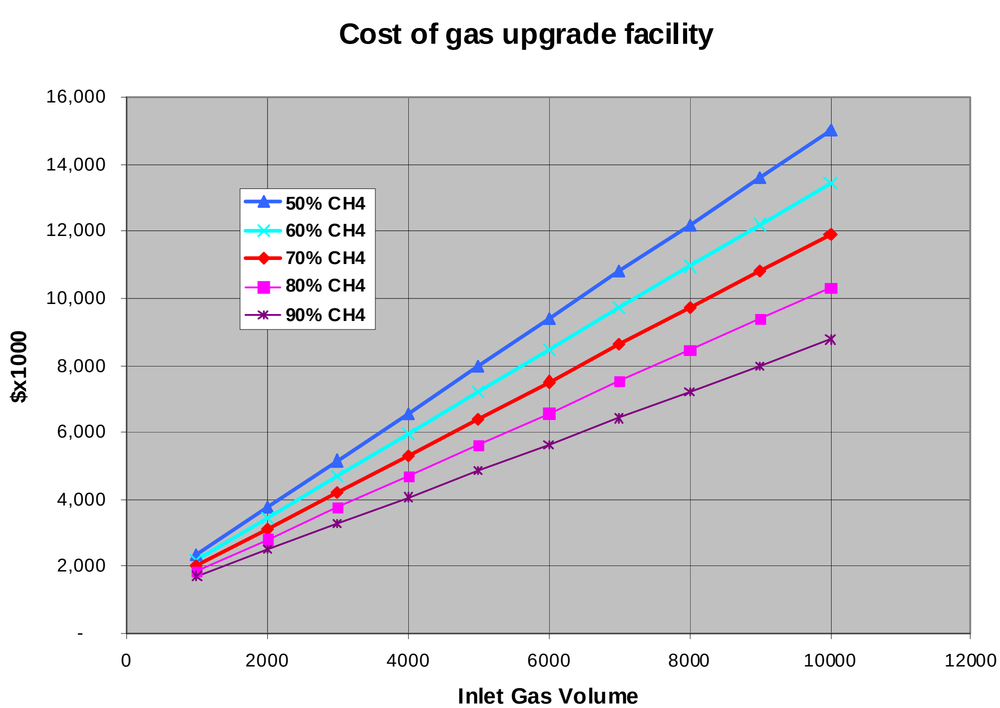


Figure 1: Example calculations at different rates and compositions

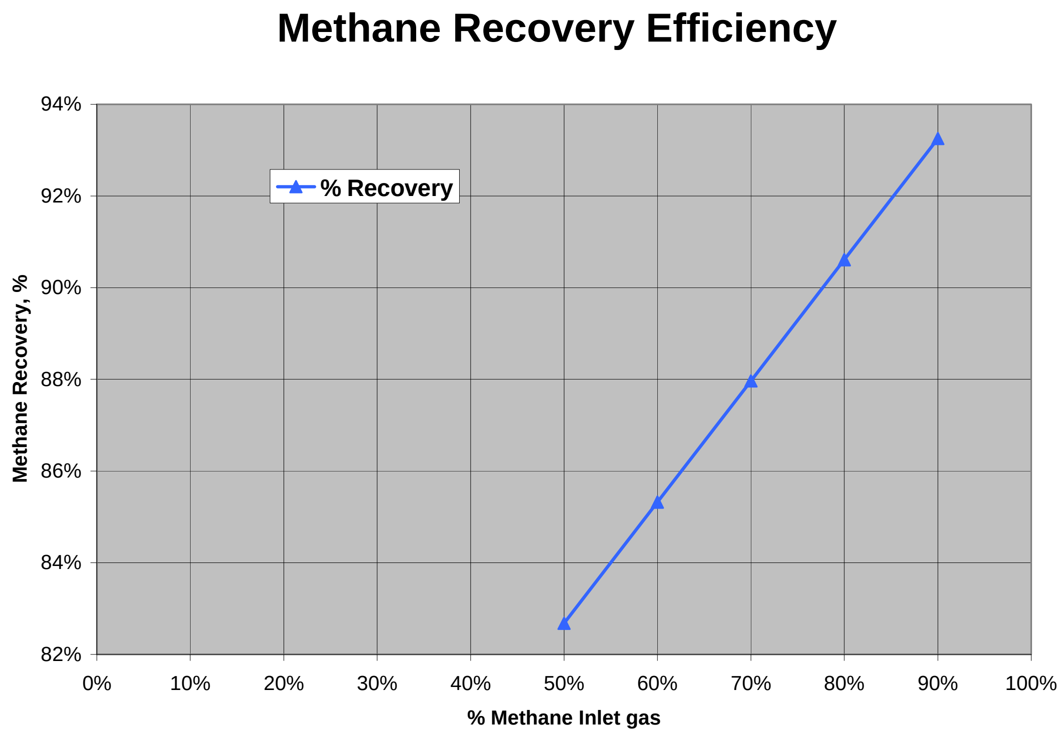


Figure 2: Percent of inlet methane recovered for sale at various inlet compositions